



## Veterans' Health Activities

Since its inception, the Centers for Disease Control and Prevention (CDC) has been involved in protecting the health of U.S. military personnel and veterans. In fact, CDC was established to address concerns about malaria among our troops during World War II. In more recent years, CDC's National Center for Environmental Health (NCEH) has taken the lead in addressing the health concerns of veterans of the Vietnam War and the Gulf War, and NCEH is working with the Departments of Defense (DoD) and Veterans Affairs (VA) to protect the health of our future military forces. NCEH's ongoing and completed activities in these areas are described below.

<b>Vietnam Studies</b>
Postservice Mortality Among Vietnam Veterans
Agent Orange Validation Study
Vietnam Experience Study
Selected Cancers Study
Postservice Mortality of Vietnam Veterans: Follow-Up of the Vietnam Experience Study Cohort
<b>Gulf War Studies</b>
Health Effects of Exposure to Smoke from Oil Well Fires
Birth Defects
Air Force Study
Health Assessment of Gulf War Veterans from Iowa



Iowa Asthma Follow-Up Study
Cognitive Function and Symptom Patterns in Gulf War Veterans
Defining Gulf War Illness
Assessing the Potential Health Impact of the Gulf War on Saudi Arabia National Guard Members
Epidemiologic Study of the Occurrence of Amyotrophic Lateral Sclerosis (ALS) Among Gulf War Veterans
Gulf War Research Planning Conference
Web Based Central Library (Medsearch)
<b>Force Health Protection</b>
Health Risk Communication Research
Behavioral Risk Factor Surveillance Survey (BRFSS)



## Vietnam Studies

### **Postservice Mortality Among Vietnam Veterans**

The postservice mortality (through December 1983) of a cohort of 9,324 U.S. Army veterans who served in Vietnam was compared with that of 8,989 Vietnam-era veterans who served in Korea, Germany, or the United States. Over the entire follow-up period, total mortality in Vietnam veterans was 17% higher than for other veterans. The excess mortality occurred mainly in the first five years after discharge from active duty and involved motor vehicle accidents, suicide, homicide, and accidental poisonings. Thereafter, mortality among Vietnam veterans was similar to that of other Vietnam-era veterans, except for drug-related deaths, which continued to be elevated. The excess in postservice mortality due to external causes among Vietnam veterans is similar to that found among men returning from combat areas after World War II and the Korean War.

#### *Study Publication:*

The Centers for Disease Control Vietnam Experience Study. Postservicemortality among Vietnam veterans. *Journal of the American Medical Association* 1987;257:790-795.

### **Agent Orange Validation Study**

This study investigated whether military records could be used to identify U.S. Army Vietnam veterans who were likely to have been exposed to the herbicide Agent Orange. Blood levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), a toxic contaminant in Agent Orange, were measured for 646 ground combat troops who served in heavily sprayed areas of Vietnam and for 97 veterans who did not serve in Vietnam. The blood TCDD levels of the Vietnam veterans were nearly identical to the levels found among the non-Vietnam veterans. In addition, the blood TCDD levels were not related to the estimate of Agent Orange exposure based on either military records or self-reported exposure.



*Study Publication:*

The Centers for Disease Control Veterans Health Studies. Serum 2,3,7,8-tetrachlorodibenzo-p-dioxin levels in US Army Vietnam-era veterans. *Journal of the American Medical Association* 1988;260:1249-1254.

**Vietnam Experience Study**

The Vietnam Experience Study was a multidimensional assessment of the health of Vietnam veterans. From a random sample of enlisted men who entered the U.S. Army from 1965 to 1971, 7,924 Vietnam and 7,364 non-Vietnam veterans participated in a telephone interview. A random subsample of 2,490 Vietnam and 1,972 non-Vietnam veterans also underwent a comprehensive health examination, including medical examination and laboratory tests and a psychological evaluation. During the telephone interview, Vietnam veterans reported current and past health problems more frequently than did non-Vietnam veterans. The Vietnam veterans also reported more health problems among their children, including more birth defects, and more problems with impaired fertility.

The results of the medical and laboratory examinations showed few current objective differences in physical health between the two groups. The Vietnam veterans did have more hearing loss. Also, among a sub-sample of 571 participants who had semen samples evaluated, Vietnam veterans had lower sperm concentrations and lower mean proportions of “normal” sperm. Despite differences in sperm characteristics, however, the Vietnam and non-Vietnam veterans had fathered similar numbers of children. An examination of hospital birth records showed that the children of Vietnam veterans were not more likely to have birth defects recorded on hospital birth records than were children of non-Vietnam veterans. The rates of birth defects were similar among children of Vietnam and non-Vietnam veterans. The psychological evaluation found that certain psychological problems were more common among the Vietnam veterans than among non-Vietnam veterans. These problems included depression, anxiety, and combat-related post-



traumatic stress disorder.

*Study Publications:*

The Centers for Disease Control Vietnam Experience Study. Health status of Vietnam veterans: I. Psychosocial characteristics. *Journal of the American Medical Association* 1988;259:2701-2707.

The Centers for Disease Control Vietnam Experience Study. Health status of Vietnam veterans: II. Physical health. *Journal of the American Medical Association* 1988;259:2708-2714.

The Centers for Disease Control Vietnam Experience Study. Health status of Vietnam veterans: III. Reproductive outcomes and child health. *Journal of the American Medical Association* 1988;259:2715-2719.

**Selected Cancers Study**

This was a population-based case-control study to determine whether Vietnam veterans are at an increased risk of developing particular types of cancer that have been suggested as being possibly related to dioxin exposure. Specific cancers studied included non-Hodgkin's lymphoma, soft tissue sarcoma, Hodgkin's disease, nasopharyngeal cancer, and primary liver cancer. An increased risk of non-Hodgkin's lymphoma was found among Vietnam veterans compared with men who did not serve in Vietnam, but no increased risk was identified for the other five cancers. The risk of having non-Hodgkin's lymphoma increased with length of service in Vietnam and was higher among men in the sea-based Navy than among other veterans. However, little difference in risk was noted according to dates of service, type of unit, military region, or any other characteristics that may have been associated with the use of Agent Orange.

*Study Publications:*

The Selected Cancers Cooperative Study Group. The association of selected cancers with service



in the US military in Vietnam: I. Non-Hodgkin's lymphoma. *Archives of Internal Medicine* 1990;150:2473-2483.

The Selected Cancers Cooperative Study Group. The association of selected cancers with service in the US military in Vietnam: II. Soft-tissue and other sarcomas. *Archives of Internal Medicine* 1990;150:2485-2492.

The Selected Cancers Cooperative Study Group. The association of selected cancers with service in the US military in Vietnam: III. Hodgkin's disease, nasal cancer, nasopharyngeal cancer, and primary liver cancer. *Archives of Internal Medicine* 1990;150:2495-2505.

### **Postservice Mortality of Vietnam Veterans:**

#### **Follow-Up of the Vietnam Experience Study Cohort**

CDC's National Center for Environmental Health (NCEH) is conducting a mortality follow-up study of 18,331 veterans who were eligible to participate in CDC's Vietnam Experience Study conducted in the 1980s. This study will provide an update on the original mortality study conducted as part of the Vietnam Experience Study. The current update will compare vital status and cause-of-death information from the end of the original mortality study (December 31, 1983) through December 31, 2000. Comparisons will be made between veterans who served in Vietnam and those who served during the time of the Vietnam War but who were not deployed to Vietnam. Results from this study are expected to be available in 2003.



## Gulf War Studies

### **Health Effects of Exposure to Smoke from Oil Well Fires**

Researchers from CDC and several other federal agencies conducted surveys of workers in Kuwait City in May 1991 and of firefighters in the oil fields in October 1991. Blood samples were tested for 31 volatile organic compounds (VOCs) and were compared with samples from a group of people living in the United States. The samples from people living in the United States were collected as part of the Third National Health and Nutrition Examination Survey (NHANES III), a national survey of the health of Americans. The median concentration of VOCs among the firefighters was quite elevated. However, among the non-firefighting personnel, VOC concentrations were equal to or lower than the levels found among the people living in the United States.

NCEH also collaborated with the DoD on a study of 30 members of an Army unit located in Germany. Blood from these military personnel was tested for VOCs at three points in time: before, during, and after their deployment to Kuwait. Only one VOC, tetrachloroethylene, was found to be elevated. This is a compound found in degreasing agents used to clean equipment.

### **Birth Defects**

In 1994, CDC collaborated with the Mississippi Department of Health and the VA to investigate reports of adverse birth outcomes among members of two Mississippi National Guard Units that served in the Gulf War. This investigation found no increase above expected rates in the total number of birth defects or in the frequency of premature birth and low birth weight. The frequency of other health problems such as respiratory infections, gastroenteritis, and skin diseases among children born to these veterans also did not appear to be elevated. The results of this study were published in the journal *Military Medicine* in 1996. (Penman A, Tarver RS, Currier MM. No evidence of increase in birth defects and health problems among children born to



Persian Gulf War veterans in Mississippi. *Military Medicine* 1996; 161:1-6).

In 1995, the Naval Health Research Center asked CDC to assist in a study of Goldenhar syndrome. Goldenhar syndrome is characterized by abnormal prenatal development of facial structures. Two clinicians from CDC reviewed birth records of 75,414 infants conceived after the Gulf War and born in military treatment facilities (34,069 infants born to Gulf War veterans, and 41,345 born to non-deployed veterans) and identified five infants with Goldenhar syndrome who were born to Gulf War veterans and two infants born to non-deployed veterans. Because of the small number of cases found by the study, the statistical power of the study was low, and it was not possible to conclude solely from this study whether there is a higher or lower risk for Goldenhar syndrome among infants born to Gulf War veterans. The results of this study were published in the journal *Teratology* in 1997. (Araneta MR, Moore CA, Olney RS, Edmonds LD, Karcher JA, McDonough C, Hiliopoulos KM, Schlangen KM, Gray GC. Goldenhar syndrome among infants born in military hospitals to Gulf War veterans. *Teratology*, 1997; 56:244-51.)

### **Air Force Study**

In November 1994, in response to reports of illness among members of a Pennsylvania Air National Guard unit that had deployed to the Gulf War, the Pennsylvania State Health Department, the VA, and DoD requested that CDC conduct an independent investigation. The investigation, carried out by CDC's National Center for Infectious Diseases, involved three phases: (1) interview and examination of ill Gulf War veterans from the Air National Guard unit (the index unit) and review of medical records to verify and characterize illness; (2) a survey of 3,723 military personnel from four Air Force units, including veterans who were and were not deployed to the Gulf War, to determine the relative prevalence of symptoms and to develop a working case definition of illness; and (3) a clinical evaluation of 158 Gulf War veterans from the index unit to further clinically characterize the illness and to identify risk factors (by examination and laboratory tests).



A case was defined as having one or more chronic symptoms from at least two of three symptom categories (fatigue, mood-cognition, and musculoskeletal). A case was further classified as severe if each case-defining symptom was rated as severe; otherwise, the case was classified as mild-to-moderate. Cases were more likely to demonstrate poorer functioning, depression, and post-traumatic stress disorder. However, no consistent abnormalities were found by physical examination, routine laboratory tests, or tests for several infectious agents endemic to the Middle East. The prevalence of mild-to-moderate and severe cases was 39% and 6%, respectively, among Gulf War veterans versus 14% and 0.7% among non-deployed veterans. Fifty-nine (37%) clinically evaluated Gulf War veterans were non-cases, 86 (54%) were mild-to-moderate cases, and 13 (8%) were severe cases. The investigators identified a chronic multisystem condition that was significantly associated with deployment to the Gulf War but was not associated with specific Gulf War exposures, and that also affected non-deployed personnel. Results from this study were published in the journals *Morbidity and Mortality Weekly Report (MMWR)*, the *Journal of the American Medical Association*, and the *Journal of Nervous and Mental Disorders*.

*Study Publications:*

CDC. Unexplained illness among Persian Gulf War veterans in an Air National Guard unit: August 1990-March 1995. *MMWR* 1995; 44:443-447.

Fukuda K, Nisenbaum R, Stewart G, Thompson WW, Robin L, Washko RM, Noah DL, Barrett DH, Randall B, Herwaldt BL, Mawle AC, Reeves WC. Chronic multisymptom illness affecting Air Force veterans of the Gulf War, *Journal of the American Medical Association* 1998;280:981-988.

Nisenbaum R, Barrett DH, Reyes M, Reeves WC. Deployment stressors and a chronic multisymptom illness among Gulf War veterans. *Journal of Nervous and Mental Disorders* 2000;188:259-266.



## **Health Assessment of Gulf War Veterans from Iowa**

In April 1994, Senator Harkin of Iowa requested that the CDC conduct a health assessment of Gulf War veterans in his state. The study was initiated in December 1994 and was conducted through a cooperative agreement between the Iowa Department of Public Health and CDC's National Center for Environmental Health. The Iowa Department of Public Health contracted with investigators at the University of Iowa who took the lead in designing and conducting the study. From September 1995 through May 1996, a telephone survey was administered to 1,896 Gulf War veterans and to 1,799 military personnel who were not deployed to the Persian Gulf.

This was one of the first population-based epidemiologic studies to document that Gulf War veterans are reporting more medical and psychiatric conditions than their military peers. The study identified several conditions that need to be studied in more detail, including cognitive dysfunction, depression, chronic fatigue, post-traumatic stress disorder, and respiratory illness (asthma and bronchitis). The conditions identified in this study appear to have had a measurable impact on the functional activity and daily lives of these Gulf War veterans. However, these conditions may not be unique to Gulf War veterans and may be similar to the experience of veterans in other wars. Among Gulf War veterans, minimal differences were observed between the National Guard or Reserve troops and the regular military personnel.

Initial results from the telephone survey were published in 1997 in the *Journal of the American Medical Association*.

### *Study Publications:*

Iowa Persian Gulf Study Group. Self-reported illness and health status among Gulf War veterans: A population-based study. *Journal of the American Medical Association* 1997; 277:238-245.

Black DW, Doebbeling BN, Voelker MD, Clarke WR, Woolson RF, Barrett DH, Schwartz DA. Quality of life and health-services utilization in a population-based sample of military personnel



reporting multiple chemical sensitivities. *Journal of Occupational and Environmental Medicine* 1999; 41:928-933.

Black DW, Doebbeling BN, Voelker MD, Clarke WR, Woolson RF, Barrett DH, Schwartz DA. Multiple chemical sensitivity syndrome: Symptom prevalence and risk factors in a military population. *Archives of Internal Medicine* 2000; 160:1169-1176.

Doebbeling BN, Clarke WR, Watson D, Torner JC, Woolson RF, Voelker MD, Barrett DH, Schwartz DA. Is there a Persian Gulf War syndrome? Evidence from a large population-based survey of veterans and nondeployed controls. *American Journal of Medicine* 2000; 108:695-704.

Zwerling C, Torner JC, Clarke WR, Voelker MD, Doebbeling BN, Barrett DH, Merchant JA, Woolson RF, Schwartz DA. Self-reported postwar injuries among Gulf War veterans. *Public Health Reports* 2000; 115:346-349.

Doebbeling BN, Jones MF, Hall DB, Clarke WR, Woolson RF, Torner JC, Burmeister LF, Snyders-Crumley T, Barrett DH, Falter KH, Merchant JA, Anderson, D, Schwartz, D. Methodologic issues in a population-based health survey of Gulf War veterans. *Journal of Clinical Epidemiology* 2002; 55:477-487.

Barrett DH, Doebbeling B, Voelker MD, Doebbeling CC, Falter K, Woolson R, Schwartz DA. Post-traumatic stress disorder and physical health status among military personnel service during the Gulf War period. *Psychosomatics* 2002; 43:195-205.

### **Iowa Asthma Follow-Up Study**

The original Iowa study was extended to collect physical examination data on a subset of the telephone survey participants to validate the self-report of asthma. Data were collected on 32



Gulf War veterans who reported asthma during the telephone survey, 42 Gulf War veterans who reported no illnesses during the telephone survey, and 20 non-Gulf War veterans who reported asthma during the telephone survey. The two groups of subjects with reported asthma were similar in symptoms, baseline pulmonary function tests, and bronchial hyperreactivity. The Gulf War veterans who reported asthma had significantly greater current symptomatology, lower baseline spirometry, and increased bronchial hyperreactivity compared with the Gulf War veterans who reported no illness during the telephone survey. No differences in smoking history were found between the two groups with asthma; however, Gulf War veterans who reported asthma were more likely to be current and past smokers than the Gulf War veterans who did not report illness.

### **Cognitive Function and Symptom Patterns in Gulf War Veterans**

In November 1997, CDC funded a study by the Boston University School of Public Health to examine potential reasons for the memory and thinking problems reported by Gulf War veterans. In one component of this study, functional magnetic resonance imaging (fMRI) was used to examine possible differences in brain activation patterns within specific areas of the brain. Gulf War veterans and their non-deployed peers with differing levels of symptoms were compared. In another component of this study, Danish armed forces personnel were tested to determine whether they are experiencing the same types of memory and thinking problems reported by U.S. troops who participated in the Gulf War. The Danish troops were also asked about any symptoms that they may be experiencing. Both Danish troops who participated in the Gulf War and troops who were not deployed to the Gulf War were tested. The results will be compared with results from a group of U.S. Gulf War veterans that the Boston University School of Public Health and the Boston VA Medical Center have been following since they returned from the Gulf War. The investigators are currently working on analyzing the data and preparing manuscripts for publication.



## **Defining Gulf War Illness**

In November 1997, CDC funded a study by the University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School to characterize and compare different approaches for defining the medically unexplained illnesses of Gulf War veterans. This study compared the symptoms of two groups of Gulf War veterans at two points in time. The study subjects included Gulf War veterans from the VA Gulf War Registry who had participated in a previous study conducted by the New Jersey researchers, and veterans who had participated in the CDC Air Force study. Data-driven case definitions for illness previously derived from these two groups of Gulf War veterans were compared with standard or existing case definitions for unexplained multi-symptom illnesses (such as chronic fatigue syndrome, fibromyalgia, and multiple chemical sensitivity) to determine which definition best characterized Gulf War veterans' unexplained illnesses. The study also tried to determine the generalizability of the derived and existing case definitions in a new random sample of deployed and non-deployed Gulf War era veterans and active duty soldiers. The investigators are currently analyzing the data and preparing manuscripts for publication.

## **Assessing the Potential Health Impact of the Gulf War on Saudi Arabia**

### **National Guard Members**

In 1999, a team of researchers from CDC, DoD, and the Saudi Arabia National Guard started an epidemiology study of Saudi National Guard troops. The goal of this study is to examine available computerized databases for unusual health trends, comparing Saudi soldiers who were stationed in a combat area in January 1991 (Al Khafji) with soldiers who were stationed in a non-combat area (Riyadh). Rates and causes of hospitalizations will be compared. The investigators are currently analyzing the data.



## **Epidemiologic Study of the Occurrence of Amyotrophic Lateral Sclerosis (ALS) Among Gulf War Veterans**

In June 1999, the VA and DoD requested that CDC assist in a study of ALS among Gulf War veterans. ALS is a fatal neurodegenerative disease that destroys the brain and spinal cord nerve cells that control muscle movement. As the brain and spinal cord nerve cells die, muscles weaken and shrink, and rapid severe paralysis occurs. Neither a cause nor a cure for ALS is known at this time. This investigation of ALS among Gulf War veterans will determine if there is a higher than expected incidence of ALS and will examine possible risk factors for the disease. CDC's Environmental Health Laboratory at NCEH will be conducting laboratory analyses of blood and urine specimens to look for signs of exposure to heavy metals.

## **Gulf War Research Planning Conference**

In early 1999, CDC, in coordination with the Office of Public Health and Science (Department of Health and Human Services), the National Institutes of Health, and the Agency for Toxic Substances and Disease Registry, sponsored a conference to obtain broad public input into the development of a multi-year research plan for investigating the relationship between chemical exposures during the Gulf War and illnesses affecting Gulf War veterans (*The Health Impact of Chemical Exposures During the Gulf War: A Research Planning Conference, February 28-March 2, 1999*). Concurrent workgroups were held to develop research recommendations in the areas of pathophysiology/etiology of illnesses among Gulf War veterans, the most appropriate methods for assessing and diagnosing the health impact of chemical exposures, the most appropriate treatment approaches, and ways to prevent similar illnesses in future military deployments. A final report summarizing conference recommendations was released in March 2000 and is accessible at <http://www.cdc.gov/nceh/publications/gulfwar/report.pdf>. The background document prepared for the conference that reviews Gulf War-related research conducted prior to 1999 is accessible at <http://www.cdc.gov/nceh/publications/gulfwar/bdgw65.pdf>.



### **Web-Based Central Library (*Medsearch*)**

CDC, the DoD's Deployment Health Support Directorate (DHSD) and the VA collaborated to create a centralized Internet site, known as *Medsearch*, where veterans and members of the armed forces can find information on Gulf War-related medical research developed by or for government agencies. The idea for the online medical library came from a recommendation at a CDC conference in 1999. The conference participants called for a central location where both veterans and researchers could access the latest research on illnesses among Gulf War veterans. The Internet site developers worked with veterans and researchers to ensure that *Medsearch* is user friendly. Many of the documents available on *Medsearch* are written in plain language.

*Medsearch* can be accessed at <http://www.gulflink.osd.mil/medsearch>.



## Force Health Protection

### **Health Risk Communication Research**

In March 2001, CDC announced funding for a grant program to develop, implement, and evaluate strategies for improving health risk communication related to military deployments among military personnel, veterans, their family members, and their health care providers.

Two health risk communication research projects were funded on September 1, 2001. One grant was awarded to Rutgers University for the project “Improving Health Risk Communications to Prevent Unexplained Illnesses Related to Military Deployments.” This project focuses on assessing knowledge, attitudes, and beliefs of ill and healthy Gulf War veterans and current active duty military personnel about chemical, biological, and radiological agents, and develops and evaluates risk communication materials regarding these agents.

The second grant was awarded to the Henry H. Jackson Foundation for the project “Health-e VOICE: Optimized Implementation of a Stepped Clinical Risk Communications Guideline.” This project focuses on the development and evaluation of an interactive, web-based distance learning tool for improving DoD health care providers’ capacity to better communicate with veterans about deployment-related health concerns.

### **Behavioral Risk Factor Surveillance Survey (BRFSS)**

In 2002, CDC’s NCEH was successful in its proposal to add veteran-related questions to the core questionnaire of the 2003 BRFSS. These questions will ask about experience in the military and use of VA health care facilities. The BRFSS is a CDC-supported telephone survey that is administered by all 50 states to collect information on behavioral factors known to be associated with chronic diseases. Information on the BRFSS can be found at <http://www.cdc.gov/brfss/>.

The addition of the questions on military experience and VA health care will be useful in



assessing the overall general health status of veterans and for collecting data on specific behavioral risk factors, such as physical activity levels, smoking, and alcohol use. The information will also assist both state and federal health officials in developing strategies for preventing and controlling health problems for the estimated 25.6 million veterans and 1.8 million active duty, reserve, and National Guard personnel in the United States.